SOFTWARE REJUVENATION ON A GRID COMPUTING ENVIRONMENT FOR HIGHER AVAILABILITY BASED ON APPROXIMATE INVERSE PRECONDITIONING

V.P. KOUTRAS1, A.N. PLATIS1 and G.A. GRAVVANIS2

1Department of Financial and Management Engineering, Business School, University of the Aegean, 31, Fostini street, GR 82100 Chios, Greece; Email: v.koutras@fme.aegean.gr, platis@aegean.gr

2 Department of Electrical and Computer Engineering, School of Engineering, Democritus University of Thrace, 12, Vas. Sofias street, GR 67100 Xanthi, Greece; Email: ggravvan@ee.duth.gr

ABSTRACT

Grid computing is an innovative technology for using geographically distributed resources in order to solve large-scale problems providing heterogeneous resources. Due to the size and the complexity of some of these problems, even supercomputers cannot sometimes solve them effectively. Thus Grid computing can be considered as a proper environment for encountering them. The main advantage of the Grid infrastructure is the fact that enables sharing, selection and aggregation of a wide variety of resources, including supercomputers, data resources, storage systems that are geographically distributed. On the other hand, Grid does not guaranty stableness of resources due to their nature and due to the diverse failures and error conditions that may appear on a Grid environment. Hence, the Grid environment availability has to be taken under consideration.

In this paper, a Grid system with star topology is studied. This system consists at first of a Resource Management System (RMS), various distributed resources in which the RMS sends tasks for execution and additionally the links between RMS and the distributed systems that contribute to the Grid. In such a system, RMS manages the Grid service by matchmaking the service requests with service offers and controls the assessing and the use of resources. In order to study Grid environment’s availability not only the availability of the system nodes, including RMS, has to be studied but furthermore the link availability has to be determined.

In order to provide higher levels of Grid availability, software rejuvenation is proposed to be performed on the RMS and on the distributed nodes. Software rejuvenation is a preventive software maintenance technique that can counteract phenomena of resource exhaustion on a computer system. When software rejuvenation is performed, it stops occasionally the running software, cleans its internal state and restarts it. Garbage collection, flushing operating system kernel tables, reinitializing internal data structures etc, might be involved in cleaning the internal state of the system.

The aim of our work is to determine optimal rejuvenation policies for the RMS and the distributed Grid nodes that can provide higher levels of Grid asymptotic availability. In detail, a star topology Grid computing environment is considered and Continuous Time Markov Chains (CTMC) are used in order to model the behavior of the studied Grid system. The implementation of software rejuvenation on each one of the system nodes and furthermore the condition of the links among them are modelled. Due to the topology of the Grid, RMS contributes more than the rest of the nodes on the system’s availability. Hence, the RMS
availability with respect to the condition of the existing links is studied and the RMS rejuvenation policy that can increase systems availability is determined. Additionally, the availability of the distributed nodes is studied in the case of performing software rejuvenation on these nodes and once again the optimal rejuvenation policies for the distributed nodes are determined.

Moreover, some indicators providing the level of the contribution of each Grid node, including the RMS, are defined and computed. These indicators take into account the software condition of the node and the corresponding link’s condition.

For studying the asymptotic availability of the aforementioned Grid system, the steady-state probabilities of each state have to be computed by solving a sparse linear system. The cost-effectiveness of iterative methods over direct solution methods for such systems is now commonly accepted. Recently, generalized explicit approximate inverse preconditioning methods have been derived and used for the efficient solution of these sparse linear systems. Hence, in this paper, explicit generalized approximate inverse preconditioning methods are used for solving efficiently such systems in order to derive the asymptotic availability having computed the steady-state probabilities of the model system.

REFERENCES


